Human Effectiveness Directorate

Visual Perception in Synthetic Environments

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Technical Objective

- **Identify requirements for, and support HEA engineers and user community in, the development and transition of new technologies for future flight simulator visual systems**

HEA Visual Systems Development for DMT

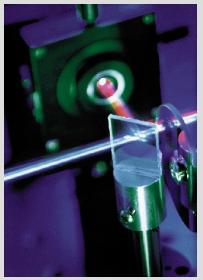
Super high-resolution laser projection technologies

High-resolution head-mounted displays (HMDs)

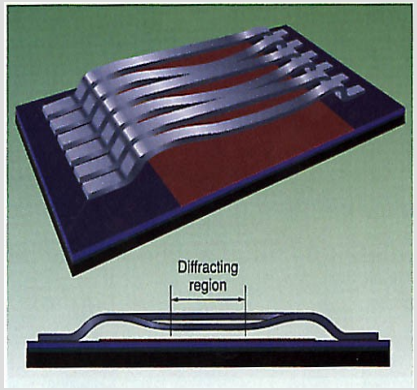
Real / collimated image screen materials

High-end versus PC-based IGs

3-D monitor development



Highly Efficient RGB Microlaser Light Sources



Grating Light Valve Linear Spatial Light Modulator

Microvision's Futuristic HMD Concept

Concept of Three-Dimensional Mission Brief/Debrief Monitor

HEA Visual Research Activities

Size, distance, and speed perception

Perceptual artifacts in HMDs

Fidelity requirements for simulator visual systems

Ultra-high resolution display design requirements

Development, test, and evaluation of emerging visual simulation technologies

- ***Laser-based parallel-scan projector displays***
- ***Liquid crystal and digital micromirror displays***
- ***Laser-based parallel-scan HMDs***
- ***PC-based image generation***

ACC F-15C Target Size Experiment

Background

ACC F-15C Mission Training Centers at Eglin AFB, FL and Langley AFB, VA are using Boeing real-image displays

ACC/DOT, ASC/YW, and Boeing requested research support to determine the degree to which airborne targets should be magnified

Prior HEA Research Results

Real (i.e., non-collimated) imagery needs to be magnified by 10-30% (depending on display distance) in order to match the perceived size of collimated imagery

Non-collimated simple imagery appears to move more slowly (3-12%, depending on display distance) than collimated simple imagery

For complex simulator imagery, we find no evidence of differences in perceived velocity between real and collimated displays

- ***Motion cues (i.e. optic flow and perspective changes) available in high-fidelity simulator imagery apparently overcome the vergence cue to object distance***

ACC F-15C Target Size Experiment

Methods

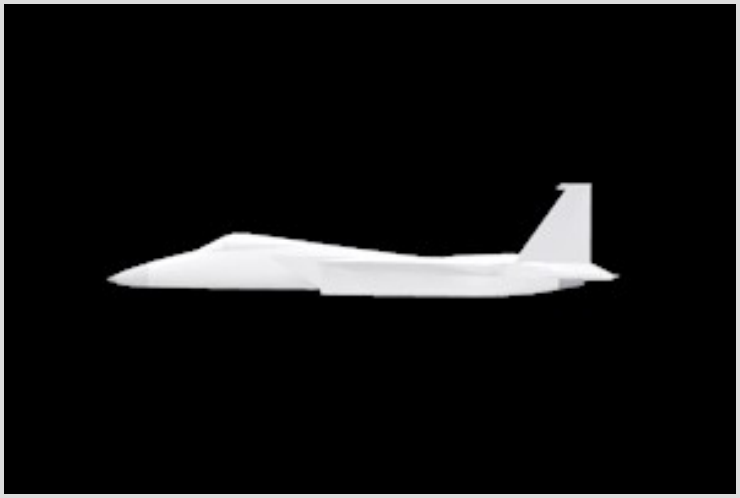
Pilots matched perceived size of real-image targets to collimated targets

Real-image viewing conditions were made equal to that of the Boeing display

- ***Real-image viewing distance was 28”***
- ***Targets were high resolution slides of F-15Cs in formation flight and flying BFM at various simulated distances on textured backgrounds***
- ***10 pilots used as observers***

Collimated/Real Display Research Apparatus

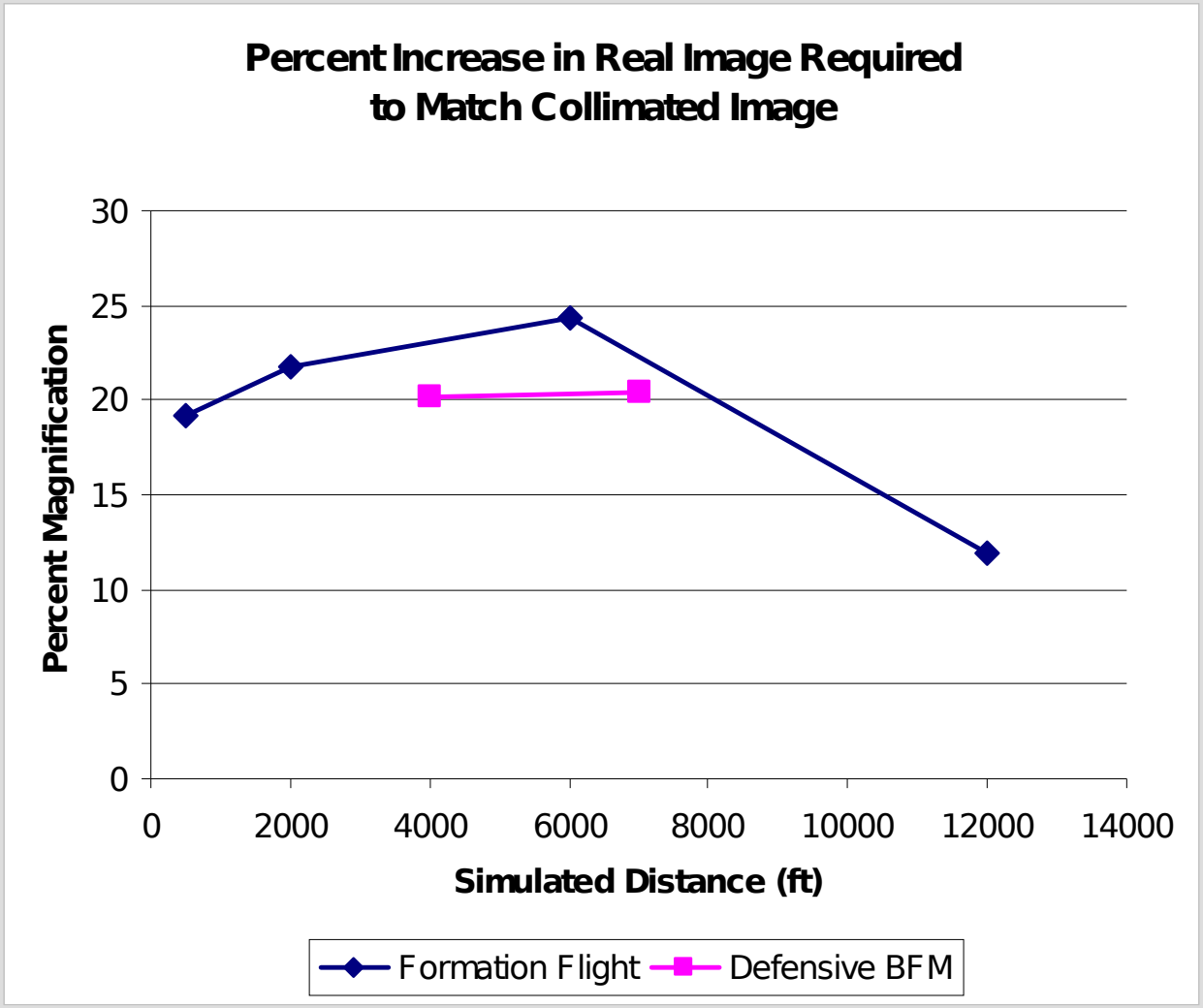
F-15C Targets



Formation Flight

Defensive BFM

ACC F-15C Target Size Experiment Results



ACC F-15C Target Size Experiment Recommendation

Implement 20% magnification of all airborne targets

- ***Best perceptual match to optical infinity environment***
- ***Anecdotally, desirable for increasing target detection and aspect recognition ranges***